

BIFOCAL INTRAOCULAR LENS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an improved intraocular lens adapted for implantation in a human eye. More specifically, the invention relates to a bifocal intraocular lens.

2. Description of the Prior Art

The basic concept of surgically providing a patient with an intraocularly implantable lens as a substitute for the human crystalline lens is generally known. Historically, such lenses have predominately been made from a high molecular weight polymer such as polymethylmethacrylate. However, U.S. Pat. No. 3,996,627 proposes the use of certain selected glass compositions, while U.S. Pat. No. 4,079,470 discloses the use of low density natural and synthetic crystal such as carborundum, sapphire, ruby, zirconium, strontium titanate, diamond and anatase. Various alternative methods and means of attaching the intraocular lens to the eye have been suggested and employed, including posterior chamber implantation, anterior chamber implantation as well as iris fixed intraocular lens. Several specific problems associated with the use of intraocular lens have been addressed in patent literature and elsewhere with varying degrees of success. For example, both U.S. Pat. Nos. 4,010,496 and 4,077,071 disclose the use of either an air space or attachment means of lower density to create a ballast effect or achieve neutral buoyancy. U.S. Pat. No. 4,010,496 also proposes the use of Fresnel optics with a lens demarcation line positioned such that as the pupil changes from the dilated state to the constricted state a bifocal effect is created. Unfortunately, such a structure allows for close vision only in relatively shaded light and exclusively far vision in bright light.

In U.S. Pat. No. 4,174,156 an optical lens for differential correction comprising two transparent walls defining an enclosed space having therein a quantity of transparent liquid with predetermined optical index is disclosed. In this lens, the bifocal effect is achieved by virtue of the liquid moving in and out of the line of sight in response to the tilting of the eye up and down, thus changing the power of the lens. However, as originally presented in U.S. Pat. No. 4,174,156, this lens is intended to be a contact lens or eyeglass lens and no method of achieving the desired bifocal effect within the physical confines of an intraocular lens is disclosed.

SUMMARY OF THE INVENTION

In view of the prior art and the problems associated with achieving a bifocal effect in an intraocular lens, I have discovered an improved intraocular lens wherein the changing of the power of the lens is achieved by the rapid transfer of a fluid between two chambers within the lens wherein the two chambers are also interconnected by a circumferential vent tube within the lens. Thus, the present invention provides an intraocular lens for implantation into a human eye comprising:

(a) an optical lens suitable for replacing a human crystalline lens wherein the optical lens consists of an inner transparent wall and an outer transparent wall which define an internal closed space within the lens wherein the internal closed space comprises:

- (i) a refractive chamber centrally located in the lens such that it is in the line of sight when the lens is implanted into an eye;
- (ii) a reservoir chamber in direct fluid communication with the refractive chamber and located in the lens such that it is in vertical alignment with the refractive chamber when the lens is implanted into an eye but not in the line of sight; and
- (iii) at least one vent tube means within the lens and not in the line of sight wherein the vent tube means establishes fluid communication between the reservoir chamber and the far edge of the refractive chamber remote to the reservoir chamber;
- (b) an eye attachment means operatively connected to the optical lens and adapted to fasten and retain the optical lens when implanted into the eye; and
- (c) a sufficient quantity of a transparent liquid means of predetermined refractive index to partially fill the internally closed space and flow between the refractive chamber and reservoir chamber, in and out of the line of sight, as the angle of inclination of the line of sight changes.

In one embodiment of the invention, the reservoir chamber is below the refractive chamber and the vent tube is a pair of fluid conduits leading from the top edge of the refractive chamber to the respective sides of the lower reservoir chamber. In another embodiment of the invention, the reservoir chamber is above the refractive chamber and the vent tube is a pair of fluid conduits leading from the lower edge of the refractive chamber to each respective side of the upper reservoir chamber.

It is an object of the present invention to provide a bifocal intraocular lens which changes focal length according to the angle of inclination of the eye by the transfer of a fluid of predetermined refractive index. It is another object of the present invention to provide a means within the intraocular lens which will insure the rapid transfer of the refractive fluid in and out of the line of sight. Fulfillment of these objects and the presence and fulfillment of additional objects will be apparent upon complete reading of the specification and claims, taken in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates an intraocular lens according to the present invention wherein the liquid reservoir is located below the refractive chamber.

FIG. 2 is a cross-sectional side view of the intraocular lens of FIG. 1.

FIG. 3 is a cross-sectional top view of the intraocular lens of FIG. 1.

FIGS. 4 and 5 are simplified cross-sectional views of an eye with an implanted intraocular lens according to the present invention illustrating how it functions.

FIG. 6 illustrates an intraocular lens according to the present invention wherein the air reservoir is located over the refractive chamber.

FIG. 7 is a side view of the intraocular lens of FIG. 6.

FIG. 8 is a top view of the intraocular lens of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The bifocal intraocular lens according to the present invention, how it functions, and how it differs from what has been previously employed can perhaps be best explained and understood by reference to the drawings. FIG. 1 illustrates the front view of one preferred em-